Algebra 2H
Quadratics Day 26 – Trajectory Problems

Name: _____
Date: _____

1) You throw a basketball from a height of 5 feet. It reaches its highest point 20 feet away from you, 30 feet in the air. The basketball hoop is 10 feet high.

   a. How far away from the hoop should you stand in order to make the shot?

   b. How far away from you does the ball land on the ground?

2) A kangaroo hops across the outback. Its typical jump lands 8 feet away from where he started and is 3 feet in the air. How high is it in the air when it is 6 feet away from where it started the jump?

3) The length of a rectangle is three more than twice the width. Determine the dimensions that will give a total area of $27m^2$. What is the minimum area that this rectangle can have?

4) Two rectangular corrals are to be made from 100yds of fencing as seen below. What should the length and width be of the rectangles in order to maximize the area?

5) The number of board feet in a 16ft long tree is approximated by the model $F(d) = 0.77d^2 - 1.32d - 9.31$ where F is the number of feet and d is the diameter of the log. How many board feet are in a log with diameter 12 inches? What is the diameter that will produce the minimum number of board feet?

6) For the years 1983 to 1990, the number of mountain bike owners m (in millions) in the US can be approximated by the model $m = 0.337t^2 - 2.265t + 3.962$, $3 < t < 10$, where $t = 3$ represents 1983. In which year did 2.5 million people own mountain bikes? In what year was the number of mountain bike owners at a minimum?

7) A ball rolls down a slope and travels a distance $d = 6t + \frac{t^2}{2}$ feet in t seconds. Find when the distance is 17 feet.

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8) The height in feet of a bottle rocket is given by $h(t) = 160t - 16t^2$ where t is the time in seconds. How long will it take for the rocket to return to the ground? What is the height after 2 seconds?

9) A foul ball leaves the end of a baseball bat and travels according to the formula $h(t) = 64t - 16t^2$ where h is the height of the ball in feet and t is the time in seconds. How long will it take for the ball to reach a height of 64 feet in the air?

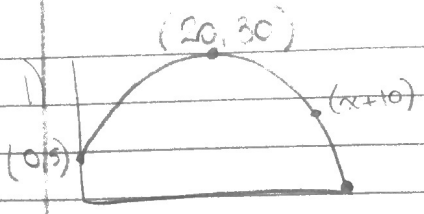
10) The formula $h = -16t^2 + 48t + 160$ gives the height of an object thrown from a building 160ft high with an initial speed of 48ft/sec where t is measured in seconds. Find the time for the object to hit the ground and find the maximum height of the object.

11) The length of a rectangular plot of land is 10 yards more than its width. If the area of the land is 600 square yards, find the dimensions of the plot of land.

12) The height of a triangular window is 3 feet less than its base. If the area of the window is 20 square feet, find the dimensions of the window.

13) Three hundred feet of fencing is available to enclose a rectangular yard alongside of the Potomac River. What dimensions will produce an area of 10,000ft^2?

1)



a) $y = a(x-h)^2 + k$

$5 = a(0-20)^2 + 30$

$5 = 400a + 30$

$-\frac{1}{16} = a$

$y = -\frac{1}{16}(x-20)^2 + 30$

$10 = -\frac{1}{16}(x-20)^2 + 30$

$-20 = -\frac{1}{16}(x-20)^2$

$320 = (x-20)^2$

$17.89 = x - 20$

$\boxed{37.89\text{ ft} = x}$

b) $y = -\frac{1}{16}(x-20)^2 + 30$

$0 = -\frac{1}{16}(x-20)^2 \cdot 30$

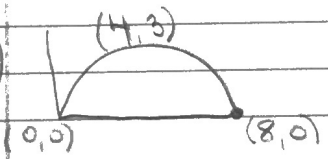
$-30 = -\frac{1}{16}(x-20)^2$

$480 = (x-20)^2$

$21.91\text{ ft} = x - 20$

$\boxed{41.91\text{ ft} = x}$

2)



$y = a(x-h)^2 + k$

$0 = a(0-4)^2 + 3$

$0 = 16a + 3$

$-3 = 16a$

$-\frac{3}{16} = a$

$y = -\frac{3}{16}(x-4)^2 + 3$

$y = -\frac{3}{16}(6-4)^2 + 3$

$\boxed{y = 2.25\text{ ft}}$

3) $L = 2w + 3$

$(w)(2w+3) = 27$

$2w^2 + 3w - 27 = 0$

$2w^2 - 6w + 9w - 27 = 0$

$2w(w-3) + 3(w-3) = 0$

$(2w+3)(w-3) = 0$

$w = -1\frac{1}{2}$ or $\boxed{3m}$

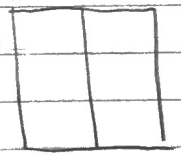
minimum area is the vertex, but the "w" value is negative. Therefore, the minimum area would be 0.

$2w^2 + 3w - 27 = 0$

$w = \frac{-b}{2a}$

$w = \frac{-3}{4}$

4)



$3x + 2y = 100$

5) $f(12) = 0.77(12)^2 - 1.32(12) - 9.31$

$\boxed{f(12) = 85.73 ft.}$

Vertex: $d = \frac{1.32}{2(.77)}$

$\boxed{d = 0.857 ft}$

6) $2.5 = 0.337t^2 - 2.265t + 3.962$ $\quad 3 < t < 10$

$0 = 0.337t^2 - 2.265t + 1.462$

$t = \frac{2.265 \pm \sqrt{2.265^2 - 4(.337)(1.462)}}{2(.337)}$

$\boxed{t = 5.916 yr}$ or ~~0.6588~~

↳ 1988

Minimum $t = \frac{-b}{2a}$

$t = 3.36$ yrs. → **1986**

7) $d = 6t + \frac{t^2}{2}$

$17 = 6t + \frac{t^2}{2}$

$34 = 12t + t^2$

$t^2 + 12t = 34$

$(t+6)^2 = 34 + 36$

$(t+6)^2 = 70$

$t + 6 \approx 8.37$

$t = 2.37$ sec

8) $h(t) = 160t - 16t^2$

$h(2) = 160(2) - 16(2)^2$

$h(2) = 256$ ft

9) $h(t) = 160t - 16t^2$

$64 = -16t^2 + 160t$

$-4 = t^2 - 10t$

$-4 + 25 = (t-5)^2$

$21 = (t-5)^2$

$4.58 \approx t - 5$ or $-4.58 \approx t - 5$

$t = 9.58$ sec or 0.42 sec

10) $-16t^2 + 48t + 160 = 0$

$t^2 - 3t - 10 = 0$

$t^2 - 3t = 10$

$(t - \frac{3}{2})^2 = 10 + \frac{9}{4}$

$(t - \frac{3}{2})^2 = \frac{49}{4}$

$t - \frac{3}{2} = \frac{7}{2}$ or $-\frac{7}{2}$

$t = 5$ s. or ~~-2~~